



Missouri Department of Natural Resources

State Parks Macroinvertebrate Inventory Report

Bryant Creek State Park Douglas County

2019–2020

Prepared for:
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1.0 Introduction

At the request of the Missouri Department of Natural Resources (**MoDNR**), Missouri State Parks (**MSP**), the Environmental Services Program (**ESP**), Water Quality Monitoring Section (**WQMS**) conducted an aquatic macroinvertebrate inventory study at Bryant Creek State Park (**BCSP**). Standard WQMS semi-quantitative protocols for the collection of macroinvertebrates and surface water samples were used at two stations within the park in spring of 2020. In addition to these sampling stations, Missouri Stream Team (**MST**) members collected macroinvertebrate samples at three different locations within BCSP using a qualitative approach.

1.1 Study Justification

Bryant Creek State Park was acquired using Natural Resources Damage and Recovery funds to compensate for groundwater contamination in Missouri. The MSP management priorities for BCSP are to restore and preserve native ecosystems in the surface- and groundwater recharge areas of their respective high-value streams to improve water quality (MoDNR 2020a). Understanding the native flora and fauna is fundamental to assessing needs and measuring success. This project provides the initial inventory and baseline for aquatic macroinvertebrates and physicochemical water samples for select representative stream reaches within BCSP.

1.2 Objectives

- 1) Inventory and examine the aquatic macroinvertebrate communities within selected representative stream reaches in BCSP.
- 2) Collect and assess physicochemical water samples within selected representative stream reaches in BCSP.

1.3 Definitions and Abbreviations

AES – Aquatic Ecological Systems
BI – Biotic Index
BCSP – Bryant Creek State Park
CAS – Chemical Analysis Section
cfs or ft³/s – cubic feet per second
CS – habitat type with flowing water over coarse substrate
EDU – Ecological Drainage Unit
EPTT – Ephemeroptera/Plecoptera/Trichoptera Taxa
ESP – Environmental Services Program
µg/L – micrograms per liter
µS/cm – microsiemens per centimeter
mg/L – milligrams per liter
MoDNR – Missouri Department of Natural Resources
MoRAP – Missouri Resource Assessment Partnership
MSP – Missouri State Parks
MST – Missouri Stream Team
NF – habitat type with depositional substrate in non-flowing water
NTU – Nephelometric Turbidity Units

QAPP – Quality Assurance Project Plan
QA/QC – Quality Assurance/ Quality Control
RM – Rootmat habitat
RP – Riffle/Pool
SDI – Shannon Diversity Index
SOP – Standard Operating Procedure
TR – Taxa Richness
USEPA – United States Environmental Protection Agency
UTM – Universal Transverse Mercator
VST – Valley Segment Types
VWQM – Volunteer Water Quality Monitoring
WQMS – Water Quality Monitoring Section

1.4 Study Area

Bryant Creek State Park is located in southern Douglas County and covers a total of 2,917 acres. The park has a steep terrain carved out by many streams and springs. A total of 4.9 miles of perennial or intermittent streams flow through the park (MoDNR 2017). The largest water feature is Bryant Creek, which borders 1.7 miles of the park's northern edge. Bryant Creek is classified as an Ozark warm-water small river and was identified in the 2005 and 2015 Missouri State Wildlife Action Plans as a state Conservation Opportunity Area (MoDNR 2017). State Highway N splits BCSP into northern and southern sections. Small streams within the north section are tributaries to Bryant Creek, and streams in the south section are tributaries to Spring Creek. Spring Creek is also a tributary to Bryant Creek.

1.5 MoRAP Aquatic Ecological Classification

The aquatic ecological classification developed by the Missouri Resource Assessment Partnership (**MoRAP**) is a classification system that divides the aquatic resources of Missouri into distinct regions. It has seven levels of classification starting at large regions and then dividing them into smaller sub-regions (Sowa et al. 2004). The following are the seven levels of classification in hierarchical order: zone, subzone, region, aquatic sub-regions, Ecological Drainage Unit (**EDU**), Aquatic Ecological Systems (**AES**), and Valley Segment Types (**VST**). The two levels of classification we focused on for this study were EDU and AES.

1.5.1 Ecological Drainage Unit

The EDU is level five of the classification hierarchy and is based on geographical variation of the taxonomic composition of the level four aquatic sub-regions (Sowa and Diamond 2006). An EDU is a region in which aquatic biological communities and habitat conditions can be expected to be similar. Bryant Creek State Park is located within the Ozark/White EDU. The Ozark/White EDU is within the Ozark aquatic sub-region and is distinguished by its karst geology, springs, and high diversity of aquatic fauna. The Ozark/White EDU contains a total of 69 fish species including four species listed as globally rare, threatened, or endangered (Sowa and Diamond 2006).

1.5.2 Aquatic Ecological Systems

Aquatic Ecological Systems are level six of the classification hierarchy. They classify aquatic systems based on geology, soils, landform, and groundwater influence. Streams within BCSP are located within the Jacks Fork AES-Type. The Jacks Fork AES-Type is characterized by karst features, alkaline groundwater, cherty and silt soils, and high gradient streams (Sowa and Diamond 2006). The geology within the Jacks Fork AES-Type consist mostly of cherty dolomites and sandstone from the Gasconade and Roubidoux formations of the early Ordovician. Springs are abundant and an important ecological feature within this AES-Type (Sowa and Diamond 2006).

2.0 Methods

Joe Chilton and Carl Wakefield of WQMS, MoDNR, Division of Environmental Quality, ESP conducted the semi-quantitative portion of this study. All WQMS staff followed standard operating procedures (SOPs) established for the collection and analysis of macroinvertebrate, flow, and physicochemical water data.

Randy Sarver (MoDNR, MST, Volunteer Water Quality Monitoring [VWQM] Coordinator), Bob Ranney (VWQM volunteer), and Allan Keller (VWQM volunteer) collected qualitative macroinvertebrate samples for the study.

2.1 Station Descriptions and Study Timing

Macroinvertebrate and discrete water quality samples were collected at two stations within BCSP using standard operating procedures on May 6, 2020. Sampling was originally planned to occur between mid-March and mid-April, but it was delayed due to the COVID-19 pandemic. The macroinvertebrate community within BCSP was compared to four other small headwater streams within the Ozark/White EDU. These stations were sampled in the spring of 2015 and 2016.

Qualitative macroinvertebrate samples were collected from three stations by MST Program volunteers on December 12, 2019; December 19, 2019; January 16, 2020; February 19, 2020; March 25, 2020; May 20, 2020; and October 8, 2020.

2.1.1 Bryant Creek State Park Sampling Stations

BCSP 1: Geographic coordinates for the upstream boundary of the station were Universal Transverse Mercator (UTM) zone 15, 550623 Easting, 4074142 Northing, and the legal description was NW ¼ Sec. 36, T. 25 N., R. 14 W. The stream name was Unnamed Tributary to Tributary of Spring Creek, hereafter referred to as Spring Branch. This station was located within the south section of BCSP, south of State Highway N. The stream was accessed from a park maintenance road. The majority of flow in the station was likely from a spring approximately 0.3 miles upstream of the sample reach. The station was high gradient and included a few small waterfalls (approximately 1-5 feet high) within a narrow “box-like” channel. Benthic habitat primarily consisted of bedrock with some stretches of coarse (gravel, pebble, and cobble) substrate. Rootmat habitat was scarce within the stream, and only three of six rootmat subsamples were collected.

BCSP 2: Geographic coordinates for the upstream boundary of the station were UTM zone 15, 550777 Easting, 4076331 Northing, and the legal description was SW $\frac{1}{4}$ Sec. 24, T. 25 N., R. 14 W. The stream name was Unnamed Tributary to Boiler Hollow (a tributary of Bryant Creek). The station was located within the north section of BCSP, north of Highway N, and on the west side of N-337D. The upper end of the station is approximately 0.1 miles west of County Road N-337D. This station contained a high gradient reach of stream with several larger (approximately 5-30 feet) waterfalls. The stream is very small, averaging 3-5 feet wide, and is likely intermittent. The only depositional habitat was located immediately downstream of waterfalls. Depositional areas contained leafy and woody debris substrate. The streambed within fast flowing habitat was primarily covered by bedrock; however, there were pockets of gravel and cobble that were targeted during sampling. Only four of six rootmat subsamples were collected within the station due to the scarcity of rootmat habitat.

2.1.2 Ozark/White EDU Candidate Reference Stations

Reference streams have the least amount of anthropogenic activities and are used as the standard by which impairment is judged (Sarver et al. 2002). These streams, which are considered the “best available and least impaired” in any given EDU, are used to measure the quality of streams within the same EDU. The macroinvertebrate community, water chemistry, and habitat of reference streams all are used as measures of stream quality. Because reference streams listed in Table I of the Missouri Water Quality Standards (MoDNR 2018e) are wadeable/perennial streams, a suite of smaller headwater “candidate” reference streams were selected to assess other headwater streams across the state. Four headwater candidate reference streams were sampled in the Ozark/White EDU. These streams include Rockhouse Hollow, Tributary to North Fork River, Natural Bridge Hollow, and Tributary to Brushy Creek (Appendix A).

Biological metric values, including taxa richness (**TR**), Ephemeroptera/Plecoptera/Trichoptera taxa (**EPTT**), biotic index (**BI**), and Shannon Diversity Index (**SDI**), were calculated for headwater reference samples and BCSP stations 1 and 2 (please see Section 2.3 for an explanation of these metrics). These headwater candidate reference metric values are presented in this report for comparison purposes only. Since the stations sampled in BCSP are smaller even than the suite of headwater candidates and were sampled outside the standard timeframe (mid-March through mid-April), no assessment valuation should be inferred from these comparisons.

2.1.3 Missouri Stream Team Stations

MST 1: Geographic coordinates for the station were Universal Transverse Mercator (UTM) zone 15, 550331 Easting, 4074347 Northing, and the legal description was NW $\frac{1}{4}$ Sec. 36, T. 25 N., R. 14 W. This station was located in Spring Branch approximately 0.2 miles upstream of BCSP 1. The station was sampled near the culvert crossing of the park maintenance road.

MST 2: Geographic coordinates for the station were UTM zone 15, 551477 Easting, 4076560 Northing, and the legal description was SE $\frac{1}{4}$ Sec. 24, T. 25 N., R. 14 W. The stream name was Unnamed Tributary to Bryant Creek. This station is located north of State Highway N on the east side of N-337D approximately 0.3 miles northeast of the house located on BCSP. The stream

flows northeast into Bryant Creek on the far northern edge of BCSP. Tributary to Bryant Creek is an intermittent stream with some areas of subsurface flow.

MST 3: Geographic coordinates for the station were UTM zone 15, 549854 Easting, 4074758 Northing, and the legal description was SE ¼ Sec. 26, T. 25 N., R. 14 W. The stream name was Unnamed Tributary to Spring Creek (not the same as Spring Branch). This station is located 0.2 miles south of State Highway N. The station was accessed through a park maintenance road that intersects a power line right-of-way, which leads to the stream. The stream flows southeast into Spring Creek outside the park boundaries.

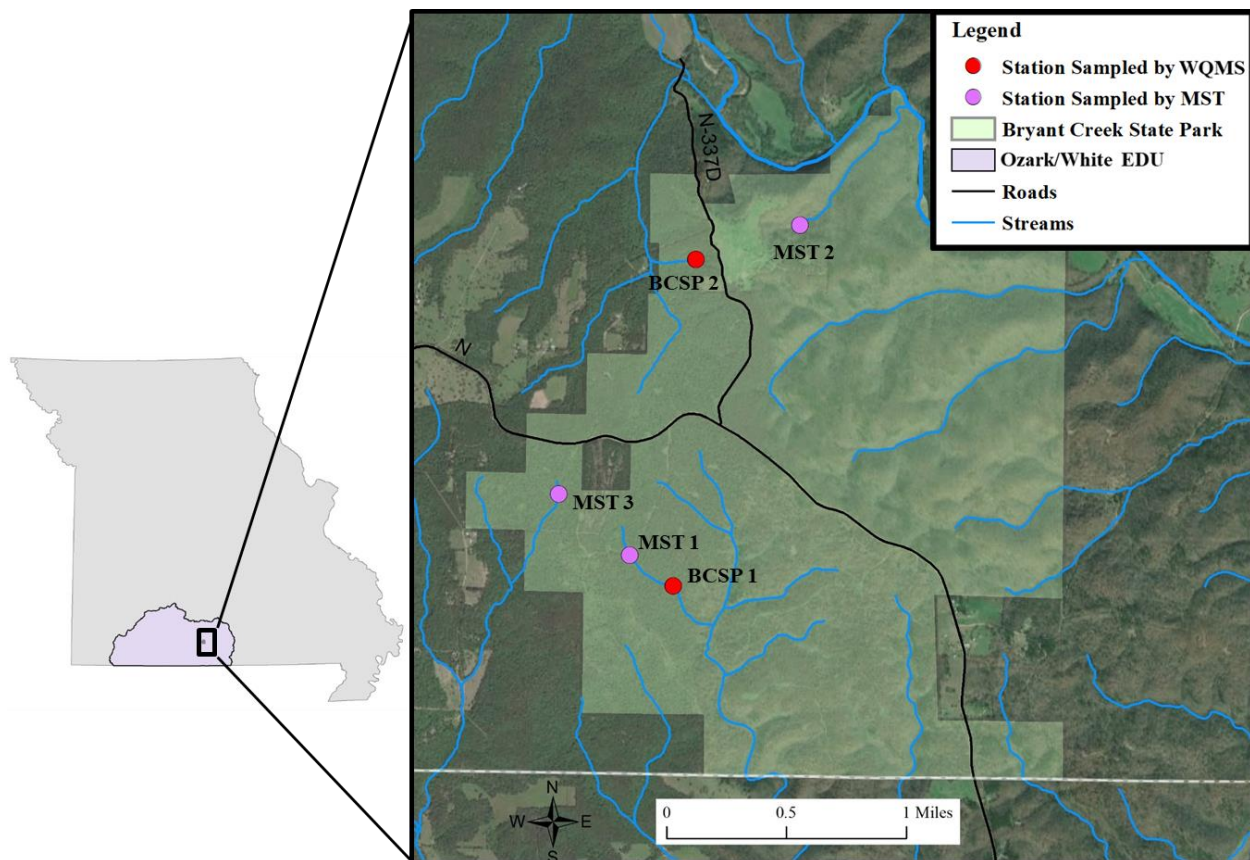


Figure 1. Location of sampling stations within BCSP and the Ozark/White EDU.

2.2 Land Use

Percent land use type and area were calculated using ArcGIS® 10.7.1 software by Esri. ArcGIS®. Land use type was determined using a 2016 layer from the National Land Cover Database (United States Geological Survey [USGS] 2016). Percent land use type and area were analyzed for each station's estimated catchment-basin. In addition, percent land use and area were determined for the BCSP boundary, Ozark/White EDU, and Jacks Fork AES-Type.

2.3 Macroinvertebrate Collection and Analysis

A standardized macroinvertebrate sample collection and analysis procedure was followed as described in the *Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure* (MoDNR 2019a) for riffle/pool (**RP**) streams. At each station, sampling occurred in three habitat types: riffle or run habitat containing coarse substrate (**CS**), depositional substrate in non-flowing water (**NF**), and rootmat (**RM**). Macroinvertebrate samples were processed at the ESP lab and analyzed using the following metrics: taxa richness (**TR**), Ephemeroptera/Plecoptera/Trichoptera taxa (**EPTT**), biotic index (**BI**), and Shannon Diversity Index (**SDI**). The following is a brief description of these metrics. A more detailed description of these metrics can be found in the *Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure* (MoDNR, 2019a).

- **Taxa Richness (TR)**

Reflects the health of the community through a measurement of the number of taxa present. In general, the total number of taxa increases with improving water quality, habitat diversity, and habitat suitability. Taxa Richness is calculated by counting all taxa from the subsampling effort.

- **Ephemeroptera, Plecoptera, and Trichoptera Taxa (EPTT)**

This value summarizes taxa richness within the insect taxonomic orders that are generally considered to be pollution sensitive (Ephemeroptera, Plecoptera, and Trichoptera). The EPTT index generally increases with higher water quality.

- **Biotic Index (BI)**

This value is a means of describing organic pollution tolerance of individual taxa within the macroinvertebrate communities expressed as a single value between 0 and 10, with 0 being the most sensitive and 10 being the most tolerant. The BI value for a macroinvertebrate sample is expressed as a weighted mean of all individuals identified in the sample.

- **Shannon Diversity Index (SDI)**

This index is a measure of community composition that takes into account both richness and evenness. It is assumed that a more diverse community is a healthier community. Shannon Diversity Index increases as the number of taxa increases and as the distribution of individuals among those taxa is more evenly distributed.

Metrics were calculated for BCSP stations 1 and 2 and all Ozark/White EDU candidate reference streams. Metric values were averaged across all candidate reference streams, and the 25th and 75th percentiles were recorded. For metric values that decrease with impairment (TR, EPTT, and SDI), any value above the 25th percentile is considered comparable to the reference streams. For metric values that increase with impairment (BI), any value below the 75th percentile is considered comparable to the reference streams (MoDNR 2019a). It is important to note again that since sampling at the BCSP stations occurred outside the standard timeframe (mid-March – mid-April) and that the BCSP stations were relatively small, comparisons to the Ozark/White candidate reference streams should be loosely interpreted. To provide insight into the

composition of the macroinvertebrate assemblages, we also analyzed percent taxa by biotic index range and the top five most dominant (abundant) order, families, and taxa for the BCSP stations.

Macroinvertebrates collected by MST members were not collected using protocols outlined in the *Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure* (MoDNR 2019a), but rather involved team members collecting aquatic or emergent macroinvertebrates by hand picking or with small nets. Specimens collected by MST were preserved and brought back to the ESP lab for identification. Metrics were not calculated for the MST stations because they were not sampled using the same standard operating procedures as the other stations.

2.4 Physicochemical Data Collection and Analysis

2.4.1 *In situ* Water Quality Measurements

In situ water quality measurements were collected at BCSP stations 1 and 2. Field measurements included water temperature (°C) (MoDNR 2018c), dissolved oxygen (mg/L) (MoDNR 2019c), conductivity (µS/cm) (MoDNR 2018d), pH (standard units) (MoDNR 2018b), and turbidity (NTU) (MoDNR 2018a).

2.4.2 Water Chemistry

Surface water grab samples were collected and returned for analyses to ESP. Water samples were analyzed by ESP's Chemical Analysis Section (CAS) for non-filterable residue, chloride, sulfate, hardness (calculated with total recoverable calcium and magnesium), total phosphorus, ammonia as N, nitrate+nitrite as N, total nitrogen, and total recoverable metals (Ca, Mg, Ba, As, Cd, Cu, Pb, Ni, and Zn).

Procedures outlined in *Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations* (MoDNR 2020b) and *Field Sheet and Chain-of-Custody Record* (MoDNR 2019b) were followed when collecting water quality samples. In the quality assurance project plan (**QAPP**) for the project (MoDNR 2020a), dissolved metals and dissolved hardness were originally intended to be analyzed from the collected water samples. Due to an equipment error in the field, total recoverable metals and hardness, rather than dissolved metals and hardness, were obtained.

2.4.3 Discharge

Stream velocity was measured at each station using a SonTek FlowTracker2 Handheld-ADV (Acoustic Doppler Velocimeter). Discharge was determined per the methods in SOP MoDNR-ESP-113, *Flow Measurement in Open Channels* (MDNR 2020c).

2.5 Quality Assurance/Quality Control (QA/QC)

2.5.1 Field Meters

All field meters used to collect water quality parameters were maintained in accordance with the SOP MDNR-ESP-213, *Quality Control Procedures for Checking Water Quality Field Instruments* (MoDNR 2016).

2.5.2 Biological Samples

Organism removal from sample debris at the ESP lab was performed consistent with those methods found in the *Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure* document (MoDNR 2019a). Macroinvertebrates found in samples taken from BCSP stations 1 and 2 and all Ozark/White EDU stations were identified to the taxonomic levels found in SOP MDNR-ESP-209, *Taxonomic Levels for Macroinvertebrate Identification* (MoDNR 2019d).

Biological samples taken by MST volunteers were identified to the lowest possible taxonomic level.

2.5.3 Biological Data Entry

Semi-quantitative macroinvertebrate data were entered into the WQMS macroinvertebrate database consistent with the SOP MDNR-ESP-214, *Quality Control Procedures for Data Processing* (MoDNR 2019f).

Taxonomic identification of MST samples were entered into an Excel workbook.

2.5.4 Duplicate Sample Collection

Duplicate samples are collected at two sampling stations per season for bioassessment samples and for 10 percent of water samples in accordance with *Quality Assurance/Quality Control for Environmental Data Collection* (MoDNR 2019e). The true samples and the duplicate samples are analyzed for the same set of parameters; however, they are analyzed and reported independently. A duplicate is used to assess the precision associated with sampling methodology, sample heterogeneity, and analytical procedures (MoDNR 2019e). No duplicate samples were taken within BCSP sampling stations for this study.

3.0 Results

3.1 Land Use

Comparison of land use between BCSP, the Ozark/White EDU, and all drainages considered Jacks Fork AES-Type showed BCSP contained far more forested land cover than the rest of the EDU and AES-Type (Table 1). The park consisted of 96 percent forested, 2 percent developed/impervious, and 1 percent hay/pasture. The forested area was primarily composed of deciduous forest (Figure 2). Developed/impervious areas mostly consisted of roads/driveways and a small house on the north section of the park property. A relatively small area ($<0.1 \text{ mi}^2$) of pasture/hay land use is found around the barn and house on the north section of BCSP. Since MSP acquired the property, there have been no farming practices taking place. Catchment area for sample stations within BCSP were small, ranging from 0.08 to 0.19 mi^2 . With the exception of MST 3, all stations' catchment-basins were entirely contained within the park boundary. Similar to land use across BCSP, these catchments were largely composed of forested land use. The BCSP station 1 catchment was entirely made up of forested land use, and BCSP 2 was a mix of forested, hay/pasture, and developed/impervious surfaces.

Table 1. Percent land use and area (square miles) for each station's catchment, Bryant Creek State Park, Jacks Fork AES-Type, and the Ozark/White EDU.

Station/ Boundary	Open Water	Developed/ Impervious	Forested	Scrub/ Herbaceous	Hay/ Pasture	Cultivated Crops	Wetlands	Area (miles ²)
BCSP 1 Catchment	0%	0%	100%	0%	0%	0%	0%	0.19
BCSP 2 Catchment	0%	10%	62.86%	0%	27.14%	0%	0%	0.05
MST 1 Catchment	0%	0%	100%	0%	0%	0%	0%	0.10
MST 2 Catchment	0%	0%	64.49%	5.31%	30.20%	0%	0%	0.08
MST 3 Catchment	0%	3.14%	96.86%	0%	0%	0%	0%	0.11
BCSP Boundary	0.02%	2.28%	96.16%	0.11%	1.44%	0%	0%	4.56
Jacks Fork AES-Type	0.39%	3.91%	71.56%	2.23%	21.39%	0.21%	0.30%	7,546
Ozark/White EDU	1.90%	6.99%	56.93%	1.94%	32.06%	0.11%	0.07%	4,732

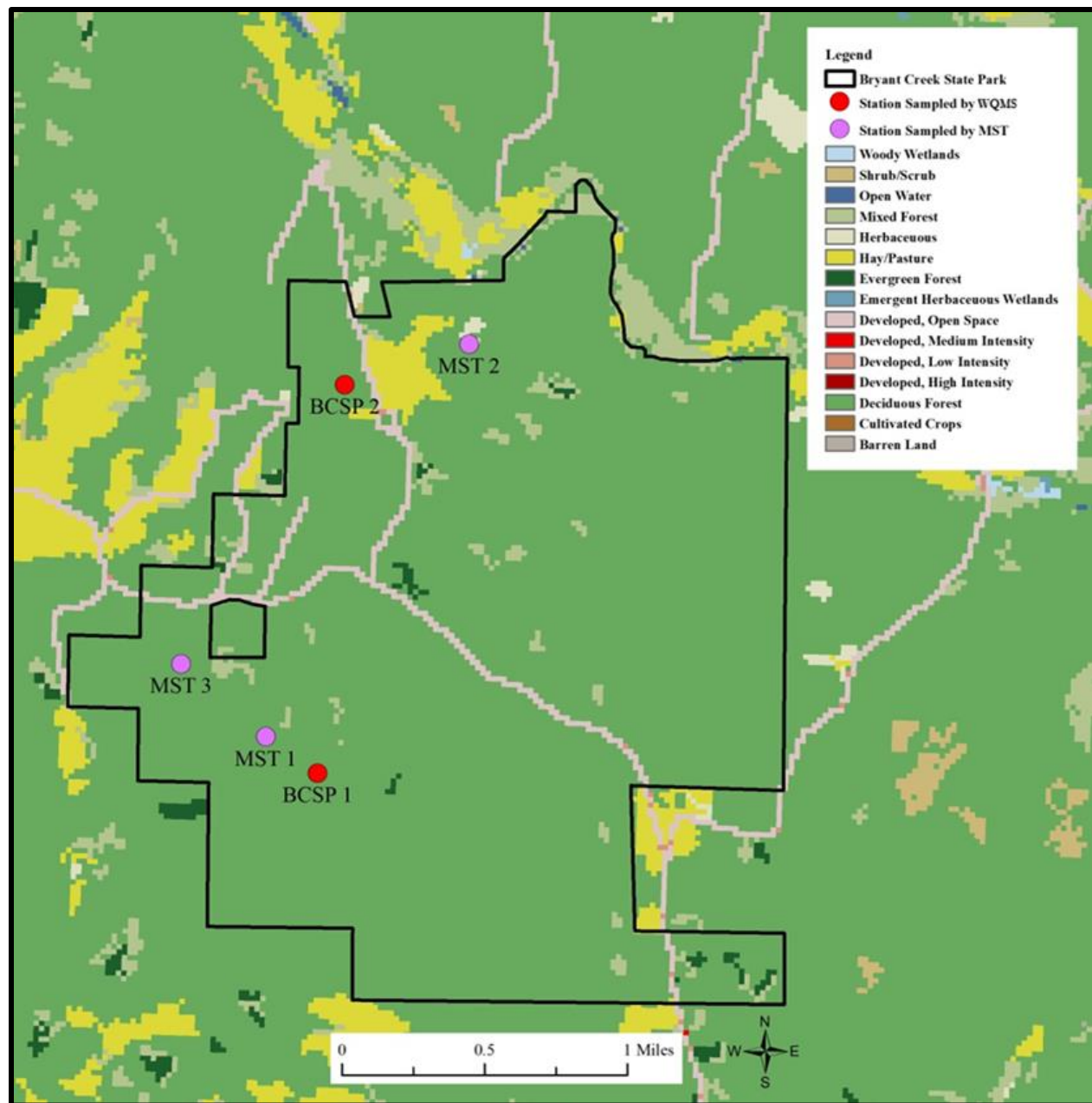


Figure 2. Land uses within BCSP and surrounding area.

3.2 Biological Survey

3.2.1 Biological Survey using Semi-quantitative Methods

Spring 2020 biological metric values for BCSP station 1 and 2 are displayed in Table 2 and Figure 3. Metric values were higher in BCSP 1 than BCSP 2 for TR, EPTT, and SDI, and lower for BI. BCSP 1 also had a higher SDI than the average value for the Ozark/White EDU candidate reference streams. The BI for BCSP 1 was lower than the 75th percentile of candidate reference streams, indicating a good composition of sensitive taxa. For TR and EPTT, BCSP 1 values were slightly lower than the 25th percentile of candidate reference streams. Station 2 did not have values that exceeded the 25th percentile for TR, EPTT, and SDI, and the BI was higher than the 75th percentile.

Table 2. Metric values for BCSP stations and Ozark/White EDU candidate reference streams.

Station	TR	EPTT	BI	SDI
BCSP 1	81	23	4.8	3.64
BCSP 2	67	15	6.1	2.80
Ozark/White EDU Headwater Candidate Reference Streams				
Average	85	27	4.7	3.36
25th percentile	82	27	4.2	3.35
75th percentile	94	31	5.0	3.62

The percent of sensitive taxa (BI<2.5) at BCSP 1 was identical to the candidate reference streams and much lower at BCSP 2 (Figure 4). The majority of taxa at BCSP 1 and the candidate reference streams was in the 5.0-7.4 BI range, and the majority of taxa at BCSP 2 was in the 7.5-8.9 BI range. Macroinvertebrate community composition at both BCSP stations was largely dominated by taxa in the order Diptera (Table 3). This was especially true for BCSP 1 where 60.7 percent of taxa were in the order Diptera. Amphipoda and Isopoda were dominant macroinvertebrate orders at BCSP 2, but these taxa were not found at BCSP 1. Plecoptera were the most abundant order of the EPTT for both stations. Top five most abundant families for BCSP 1 included Chironomidae, Leuctridae, Simuliidae, Leptophlebiidae, and Psephenidae. Top five families at BCSP 2 were Chironomidae, Asellidae, Crangonyctidae, Leuctridae, and Baetidae (Table 3). The most dominant taxon at BCSP 1 was Leuctridae (a family of stoneflies) and the most dominant taxon at BCSP 2 was *Lirceus* (a genus of isopod crustaceans).

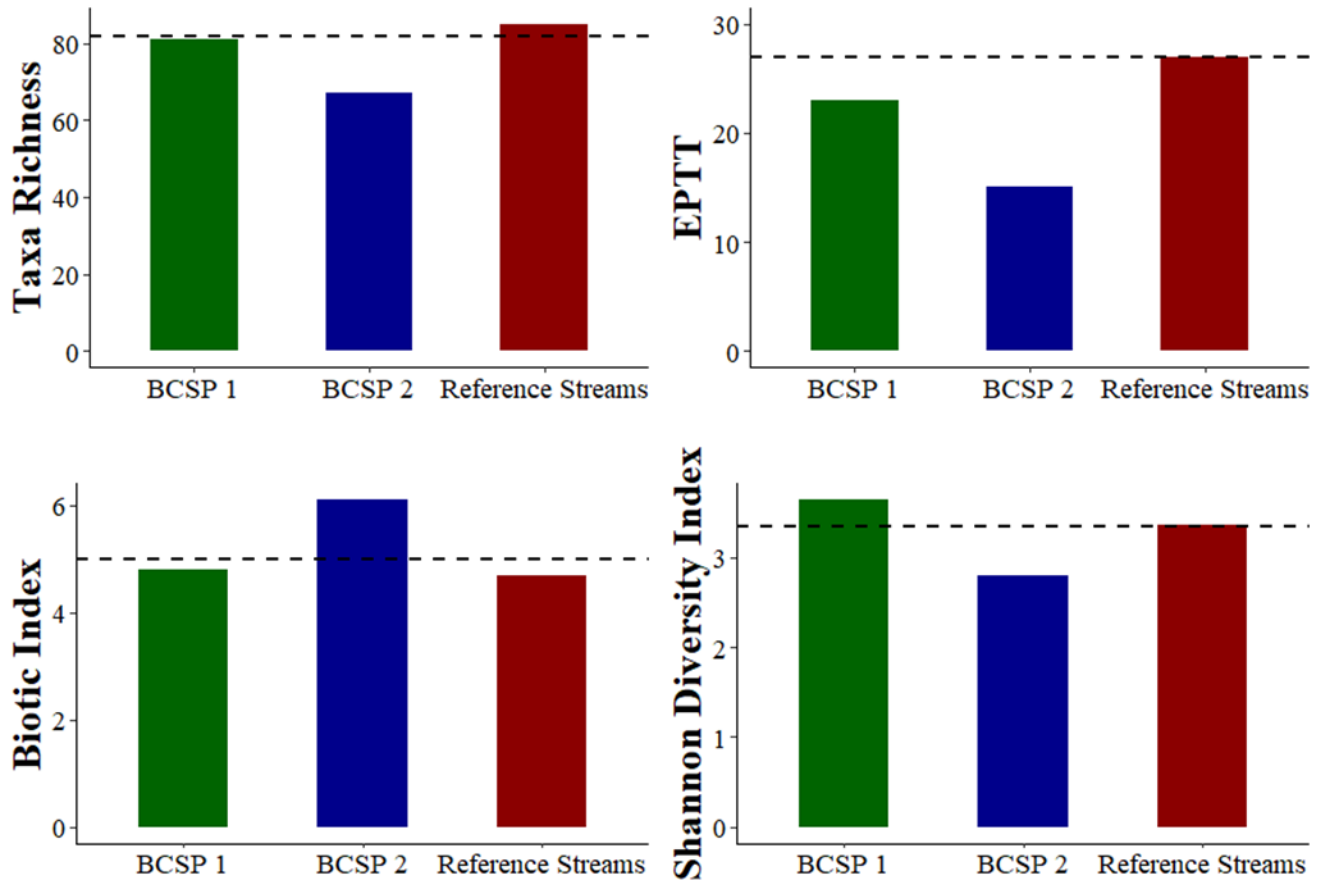


Figure 3. Bar chart of metric values for BCSP stations and Ozark/White EDU candidate reference streams. The black dotted line represents the value of the 25th percentile of the candidate reference streams for TR, EPTT, and SDI, and the 75th percentile for BI.

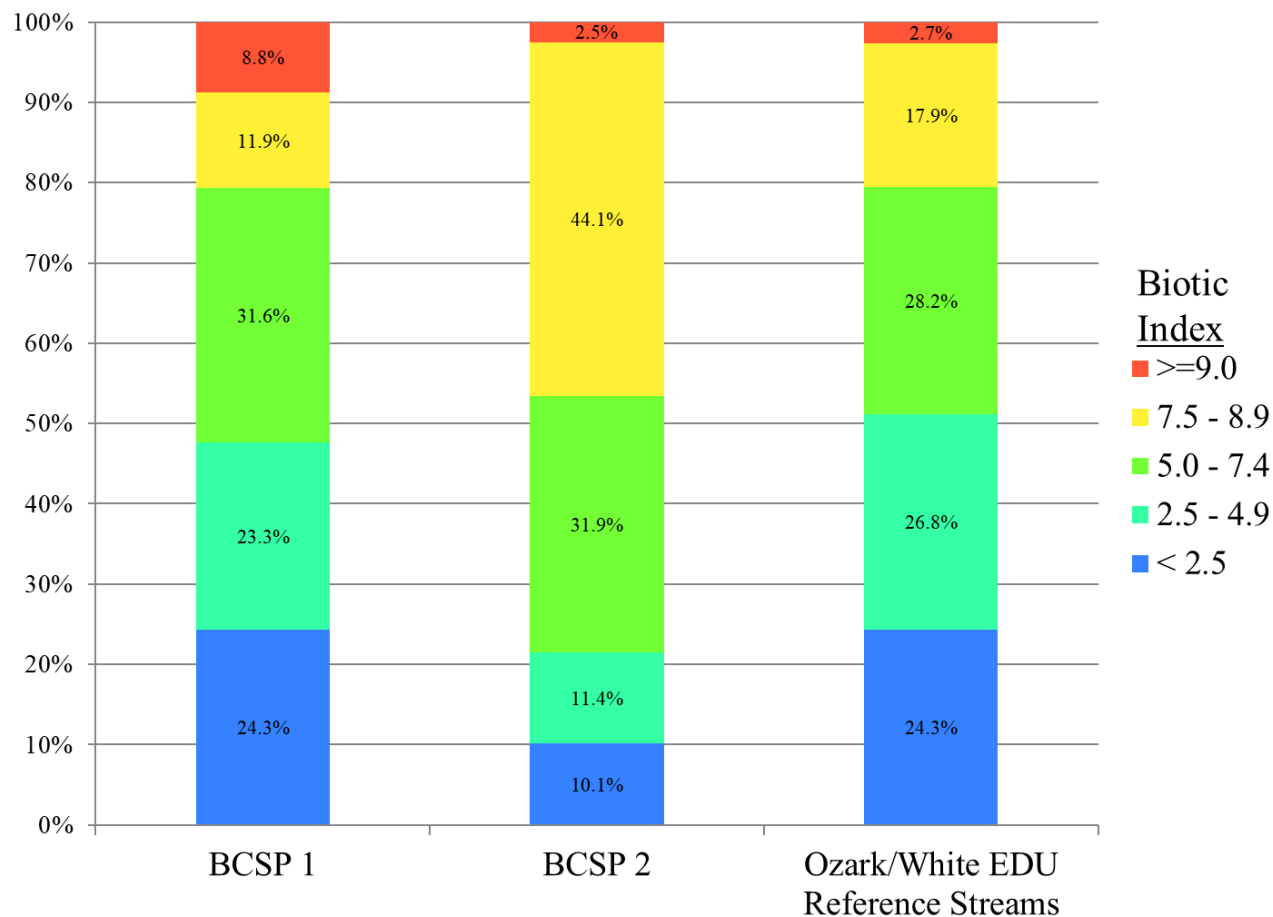


Figure 4. Percent taxa by biotic index range for BCSP stations and Ozark/White EDU candidate reference streams.

Table 3. Percent EPT and dominant macroinvertebrate orders, families, and taxa at BCSP stations. Bolded text indicates the order, family, or taxon is in the top five for the listed station.

<u>% EPTT</u>	<u>BCSP 1</u>	<u>BCSP 2</u>
Ephemeroptera	4.7	4.7
Plecoptera	18.6	7.5
Trichoptera	4.3	3.7
Total EPT	27.6	15.9
<u>% Dominant Orders</u>		
Diptera	60.7	34.7
Plecoptera	18.6	7.5
Ephemeroptera	4.7	4.7
Trichoptera	4.3	3.7
Coleoptera	4.0	3.3
Isopoda	0.0	28.2
Amphipoda	0.0	14.4
<u>% Dominant Families</u>		
Chironomidae	53.5	31.3
Leuctridae	14.6	4.7
Simuliidae	4.6	0.0
Leptophlebiidae	2.4	0.0
Psephenidae	2.4	2.0
Baetidae	1.5	4.4
Asellidae	0.0	28.2
Crangonyctidae	0.0	14.4
<u>% Dominant Taxa</u>		
Leuctridae	14.6	4.7
<i>Larsia</i>	5.1	0.0
<i>Microtendipes</i>	4.7	8.4
<i>Simulium</i>	4.6	0.0
<i>Tribelos</i>	3.9	0.1
<i>Tvetenia bavarica</i> grp.	3.9	3.0
<i>Lirceus</i>	0.0	28.2
<i>Crangonyx</i>	0.0	14.4
<i>Paratendipes</i>	1.4	7.2

3.2.2 Biological Survey at Missouri Stream Team Stations

MST volunteers collected 56 taxa among three stations in BCSP (MST 1, 2, and 3). Of these taxa, 31 were of the orders Ephemeroptera, Plecoptera, and Trichoptera. A list of collection data from these stations can be found in Appendix B. Taxonomic data collected by MST volunteers represent several sampling events from December 2019 – October 2020.

3.3 Physicochemical Water Sample Analysis

All physicochemical parameters analyzed from BCSP station 1 and 2 met Missouri's Water Quality Standards (MoDNR 2018e). With the exception of barium, metals concentrations at both stations were very low to non-detectable (Table 3). Nutrient concentrations were considerably higher in BCSP 2 than BCSP 1. There are currently no nutrient criteria in place for Missouri streams and rivers. The United States Environmental Protection Agency's (USEPA) recommended values for nutrients and turbidity in the Ozark Highlands ecoregion are as follows: 0.239 mg/L nitrate + nitrite; 0.379 mg/L total nitrogen; 0.007 mg/L total phosphorus; and 1.425 NTU turbidity (USEPA 2000). BCSP 2 exceeded USEPA's recommended nutrient concentrations, and BCSP 1 exceeded the recommended total phosphorus level (values in bold).

Table 4. Water quality measurements and physicochemical analysis for BCSP sampling stations.

Variable	BCSP 1	BCSP 2
Sample Number	20002238	20002244
Sample Date	05/06/2020	05/06/2020
Sample Time	1240h	1515h
Water Temperature (°C)	14.8	13.9
Dissolved Oxygen (mg/L)	10.35	9.8
Discharge (cfs)	0.1	0.05
Conductivity (µS/cm)	346.0	351.0
Turbidity (NTU)	0.77	2.41
pH	8.3	7.8
Ammonia as N (mg/L)	<0.02 ND	<0.02 ND
Nitrate + Nitrite as N (mg/L)	<0.008 ND	1.013
Total Nitrogen (mg/L)	0.09	2.32
Total Phosphorus (mg/L)	0.027	0.23
Chloride (mg/L)	<1.5 ND	4.67 ⁺
Sulfate (mg/L)	5.93	5.44
Total Suspended Solids (mg/L)	<5.0 ND	<5.0 ND
Calcium – Total Recoverable (mg/L)	37.9	35.7
Magnesium – Total Recoverable (mg/L)	22.4	20.8
Hardness as CaCO ₃ (mg/L)	187.0	175.0
Arsenic – Total Recoverable (µg/L)	<0.625* ND	<0.625* ND
Barium – Total Recoverable (µg/L)	35.4*	37.4*
Cadmium – Total Recoverable (µg/L)	<0.125* ND	<0.125* ND
Copper – Total Recoverable (µg/L)	<0.625* ND	<0.625* ND
Lead – Total Recoverable (µg/L)	<0.625* ND	<0.625* ND
Nickel – Total Recoverable (µg/L)	<0.625* ND	<0.625* ND
Zinc – Total Recoverable (µg/L)	1.2 ⁺⁺	<0.625* ND

*Sample was diluted during analysis

+ Estimated value; result between method detection limit and practical quantitation limit

ND not detected at reported value

4.0 Discussion

4.1 Land Use

The BCSP area contained a higher composition of forested land use than the rest of the Ozark/White EDU. Studies by Harding et al. (1998), Lenat and Crawford (1994), and Roth et al. (1996) found percent forested land within catchments was related to greater biotic diversity and integrity. Water drained from the BCSP landscape feeds small headwater streams within the park that are tributaries to Bryant Creek and Spring Creek. A segment of Bryant Creek is listed as an Outstanding State Resource Water four miles upstream from the park's boundary (MoDNR 2018e). Protection and good stewardship of the predominantly forested landscape within the park will help conserve the water quality and diverse biotic community in Bryant Creek and its tributaries.

4.2 Biological Survey

The biological survey conducted at BCSP revealed BCSP 1 (Spring Branch) contained greater macroinvertebrate diversity and more sensitive taxa than BCSP 2 (Trib. to Boiler Hollow). The difference in metric values might be because BCSP 1 is likely a perennial stream segment, whereas BCSP 2 appears to be an intermittent stream. The differences in macroinvertebrate communities between perennial and intermittent streams is well documented (Delucchi 1988; Feminella 1996; Kelso and Entekin 2018; Williams 1996). In general, macroinvertebrate diversity is lower in intermittent streams (Williams 1996), and aquatic communities are often dominated by non-insect taxa that can withstand periodic drying events (Kelso and Entekin 2018). *Lirceus* (Isopoda) and *Crangonyx* (Amphipoda) together made up 42.5 percent of taxa collected at BCSP 2. The abundance of these two non-insect taxa suggest BCSP 2 is an intermittent stream.

With the exception of SDI at BCSP 1, the two stations' metric values scored lower than the average of the Ozark/White EDU candidate reference streams. Comparisons made between the two BCSP stations and the Ozark/White candidate reference streams should be loosely interpreted because the two BCSP streams were sampled outside the typical sampling period (mid-March – mid-April). These streams are also much smaller and have higher gradients than the candidate reference streams. The average discharge for candidate reference streams was 3.4 cubic feet per second (cfs) compared to 0.1 and 0.5 cfs at BCSP stations 1 and 2, respectively. The percent sensitive/intolerant taxa (BI<2.5) at BCSP 1 was similar to the candidate reference streams, indicating good water quality. BCSP 2 contained fewer sensitive taxa than the reference streams, but this is likely because the candidate reference streams contain more water throughout the year than BCSP 2.

4.2.1 Notable Taxa

Due to the variable habitat conditions, headwater streams often support distinctive macroinvertebrate communities and taxa (Meyer et al. 2007). In BCSP we collected several taxa that are either rarely captured or are endemic to a relatively small geographical area. A few of the notable taxa collected by MST and WQMS personnel at BCSP are listed in Table 5. It is important to note that WQMS personnel rarely collect samples from very small headwater

streams that contain extreme gradients (waterfalls). These taxa might be common, but just rarely collected or studied.

Table 5. Notable taxa collected in BCSP.

Order	Species	Stream	Why is Specimen Unique?	References
Diptera	<i>Bittacomorpha clavipes</i>	Spring Branch	-new state record -inhabits small streams near springs/seeps	Bowles 1998; Fasbender & Courtney 2017
Diptera	<i>Ptychoptera spp.</i>	Trib. Boiler Hollow	-rarely collected by WQMS	
Odonata	<i>Archilestes grandis</i>	Spring Branch	-rarely collected by WQMS -largest damselfly in North America	Borkin 1985
Odonata	<i>Libellula semifasciatus</i>	Trib. Spring Creek	-rarely collected by WQMS	
Plecoptera	<i>Isoperla ouachita</i>	Spring Branch; Trib. Spring Creek	-Ozark/Ouachita Mountains endemic -sensitive to pollution	Stark & Stewart 1973
Trichoptera	<i>Diplectrona modesta</i>	Spring Branch, Trib. Bryant Creek; Trib. Spring Creek; Trib. Boiler Hollow	-rarely collected by WQMS -inhabits headwater streams and dependent on allochthonous inputs - sensitive to pollution	Cushman et al. 1977; Imhof & Harrison 1981;
Trichoptera	<i>Frenesia missa</i>	Trib. Spring Creek; Spring Branch	-never before collected by WQMS -inhabits spring seeps -sensitive to pollution	Flint 1956; Moulton & Stewart 1996
Trichoptera	<i>Paduniella nearctica</i>	Trib. Spring Creek	-rarely collected by WQMS -spring obligate that inhabits headwater streams -Ozark endemic -sensitive to pollution	Cordeiro 2004; Moulton & Stewart 1996; Wiggins 1996

Probably the most notable taxa collected at BCSP were *Bittacomorpha clavipes*, *Frenesia missa*, and *Paduniella nearctica*. Although *B. clavipes* has a range that extends across most of the United States, it has not been recorded in Missouri (Fasbender and Courtney 2017). It is known to inhabit small spring-influenced headwater streams (Bowles 1998). Both *B. clavipes* and *Ptychoptera spp.* collected in this study are commonly known as “Phantom Crane Flies.” Adult Phantom Crane Flies are characterized by long black- and white-banded legs and light bodies that seem to gracefully float through the air. *Frenesia missa*, a species of caddisfly, had never been collected by WQMS personnel in 26 years of macroinvertebrate sampling. Flint (1956) described *F. missa* as a species that inhabits seepage areas with clean, unpolluted water. Their intolerance to pollution is represented by the lowest possible BI value of 0 (MoDNR 2019d).

Paduniella nearctica is another caddisfly that inhabits seeps/springs in unpolluted headwater streams (Moulton and Stewart 1996). *Paduniella nearctica* are endemic to the Ozark Highlands of Missouri and Arkansas (Moulton and Stewart 1996; Wiggins 1996). Due to their limited distribution and vulnerability to alterations in water hydrology, *P. nearctica* are ranked as “Imperiled” by NatureServe (Cordeiro 2004).

4.3 Physicochemical Water Sample Analysis

In situ physicochemical water quality measurements were similar between the two stations for dissolved oxygen, temperature, and conductivity. Dissolved oxygen levels were high at both stations, likely because a series of small waterfalls aerate the water. Although there was only a 0.9 °C difference in temperature between the two stations, we predict seasonal temperature fluctuations will be less variable in BCSP 1 than BCSP 2 due to the discharge from the spring upstream of BCSP 1. BCSP 1 discharge was approximately double that of BCSP 2. Likewise, catchment area for BCSP 1 was nearly four times that of BCSP 2. Turbidity was higher in BCSP 2 than BCSP 1. Turbidity in the two streams was likely elevated due to a rain event that released 0.9 inches of precipitation within 48 hours of sampling.

Both BCSP stations met Missouri’s Water Quality Standards (MoDNR 2018e). Total recoverable metals, sulfate, and chloride concentrations were low at both stations. Nutrients were considerably higher at BCSP 2 than BCSP 1. Levels at BCSP 2 exceeded USEPA recommended values for nitrate + nitrite, total nitrogen, total phosphorus, and turbidity (USEPA 2000). The high gradient topography and land use around BCSP 2 might explain the increase in turbidity and nutrients in the station. The high gradient topography creates energy for water to easily erode and suspend sediment. Within the catchment of BCSP 2 there is 27 percent hay/pasture and 10 percent developed/impervious land use. Catchments with increased agriculture and developed/impervious land uses typically have higher nutrient levels (Klein 1979; Lenat and Crawford 1994). The developed/impervious land use is mostly due to County Road N-337D that is 0.1 miles from the station, and the hay/pasture land is from a small farm. Although farming practices no longer take place, research indicates that land use can affect water quality and stream diversity many years later (Harding et al. 1998).

5.0 Conclusion

In addition to the picturesque Bryant Creek that borders the park, BCSP contains a network of stunning small streams and springs amongst a rolling landscape. These headwater streams contain a unique assemblage of macroinvertebrates, including species never before collected by WQMS personnel. To preserve these unique and diverse macroinvertebrate communities that inhabit these streams, it is important to protect the landscape within their catchment basins. Changes to the landscape should be made with caution due to the high erodibility of sediments in this area. The results of the physicochemical analysis and presence of sensitive taxa in the biological survey suggest sufficient water quality for sustaining aquatic life at this time. Future water quality and biological monitoring will aid in detecting changes in aquatic health within BCSP.

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Submitted by:

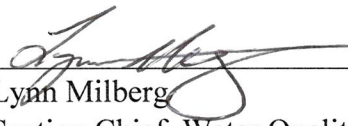
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Date:

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_____
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State Parks

Appendix A

Location information for bioassessment stations in Bryant Creek State Park and the Ozark/White EDU.

Stream Name	WBID/ Stream Miles	UTM Zone 15 Coordinates	Legal Location	Location Description
Spring Branch (BCSP 1)	2552/ 4.9/1.8/0.3	550623 E. 4074142 N.	NW ¼ Sec. 36, T. 25N., R. 14W	0.6 miles south of Hwy N in BCSP
Trib. to Boiler Hollow (BCSP 2)	2535/ 18.5/1.1/0.2	550777 E. 4076331 N.	SW ¼ Sec. 24, T. 25N., R. 14W	0.1 miles west of N- 337D
Spring Branch (MST 1)	2552/ 4.9/1.8/0.5	550331 E. 4074347 N.	NW ¼ Sec. 36, T. 25N., R. 14W	0.5 miles south of Hwy N in BCSP
Trib. to Bryant Creek (MST 2)	2535/ 17.5/0.7	551477 E. 4076560 N.	SE ¼ Sec. 24, T. 25N., R. 14W	0.3 miles NE of house in BCSP
Trib. to Spring Creek (MST 3)	2553/ 0.2/1.5/1.0	549854 E. 4074758 N.	SE ¼ Sec. 26, T. 25N., R. 14W	0.2 miles south of Hwy N
Rockhouse Hollow	2518/ 1.1/0.3/0.2	580802 E. 4087060 N.	SE ¼ Sec. 13, T. 26N., R. 11W	Near Hwy AP
Trib. North Fork River	2507/ 29.4/0.8	575503 E. 4096024 N.	NE ¼ Sec. 21, T. 27N., R. 11W	Near Forest Service Rd. 427
Natural Bridge Hollow	2415/ 0.7	433170 E. 4052182 N.	SE ¼ Sec. 16, T. 22N., R. 26W	0.7 miles above Rock Creek
Trib. Brushy Creek	2478/ 6.4/2.0/1.1	514545 E. 4060988 N.	NW ¼ Sec. 09, T. 23N., R. 17W	1.1 miles above Brushy Creek

Appendix B

Bryant Creek State Park macroinvertebrate taxa lists

Semi-quantitative kick-net WQMS collections of macroinvertebrates from Spring Branch (BCSP 1), Douglas County, Missouri in the spring of 2020. * = taxon found in large and rare; Habitats: CS = coarse substrate, NF = nonflow, RM = rootmat.

ORDER: TAXA	Habitat		
	CS	NF	RM
BASOMMATOPHORA			
<i>Menetus</i>		3	
<i>Physella</i>		6	13
COLEOPTERA			
Dytiscidae		1	
<i>Ectopria nervosa</i>	12	13	2
<i>Helichus fastigiatus</i>			1
<i>Heterosternuta</i>			3
<i>Stenelmis</i>	8		4
DECAPODA			
<i>Faxonius punctimanus</i>	*	1	
DIPTERA			
Ceratopogoninae	4	4	6
<i>Chaetocladius</i>	1	1	1
Chironomidae	2	1	
<i>Chironomus</i>			2
<i>Constempellina</i>	1		
<i>Corynoneura</i>	6	3	6
<i>Cricotopus/Orthocladius</i>	18	5	14
<i>Dicrotendipes</i>		7	
<i>Dixa</i>	1		3
<i>Eukiefferiella</i>	5		14
<i>Larsia</i>	17	25	14
<i>Micropsectra</i>	11	3	21
<i>Microtendipes</i>	6	42	4
<i>Natarsia</i>	1	25	
<i>Neozavrelia</i>	4		
<i>Nilotanypus</i>	3	1	1
<i>Parametriocnemus</i>	19	1	9
<i>Paratendipes</i>		15	
<i>Polypedilum aviceps</i>	33		9

ORDER: TAXA	Habitat		
	CS	NF	RM
<i>Polypedilum tritum</i>	1		1
<i>Pseudolimnophila</i>	7		2
<i>Rheotanytarsus</i>			1
<i>Simulium</i>	19		32
<i>Stempellina</i>	1		6
<i>Stempellinella</i>	6	6	4
<i>Stictochironomus</i>		21	
<i>Synorthocladius</i>	1		
Tabanidae		1	
<i>Tanytarsus</i>	3	2	5
<i>Thienemanniella</i>	15	1	15
<i>Thienemannimyia</i> grp.	19	1	4
<i>Tipula</i>	1		*
<i>Tribelos</i>		43	
<i>Tvetenia bavarica</i> grp	26	2	15
<i>Zavreliomyia</i>		40	2
EPHEMEROPTERA			
<i>Acentrella</i>			2
<i>Baetis</i>	1		2
<i>Centroptilum</i>		5	
<i>Diphetor</i>	6		1
<i>Habrophlebiodes</i>	10		1
<i>Paraleptophlebia</i>	6	4	6
<i>Stenonema femoratum</i>		8	
LEPIDOPTERA			
Noctuidae	1		
LUMBRICINA			
Lumbricina	2	1	1
LUMBRICULIDA			
Lumbriculidae	1	7	2
NEOTAENIOGLOSSA			
Hydrobiidae			1
ODONATA			
<i>Argia</i>			2
<i>Boyeria</i>			1
<i>Calopteryx</i>			2
Gomphidae			1
<i>Somatochlora</i>			1
<i>Stylogomphus albistylus</i>	2		
PLECOPTERA			

ORDER: TAXA	Habitat		
	CS	NF	RM
<i>Acroneuria</i>	2	*	
<i>Alloperla</i>	3		
<i>Amphinemura</i>	12		10
Leuctridae	142	3	17
<i>Perlesta</i>	15		2
TRICHOPTERA			
<i>Chimarra</i>			1
<i>Frenesia</i>			2
<i>Helicopsyche</i>			*
<i>Hydroptila</i>	3		7
<i>Ironoquia</i>			1
<i>Lepidostoma</i>	4	4	4
<i>Molanna</i>		1	
<i>Polycentropus</i>	7		1
<i>Pycnopsyche</i>		1	1
<i>Rhyacophila</i>	1		*
<i>Wormaldia</i>	10		
TRICLADIDA			
Planariidae	4		2
TUBIFICIDA			
Enchytraeidae			21
<i>Limnodrilus hoffmeisteri</i>		1	
Tubificidae	1	3	2
VENEROIDA			
Pisidiidae		2	1

Semi-quantitative kick-net WQMS collections of macroinvertebrates from Tributary to Boiler Hollow (BCSP 2), Douglas County, Missouri in the spring of 2020. * = taxon found in large and rare; Habitats: CS = coarse substrate, NF = nonflow, RM = rootmat.

ORDER: TAXA	Habitat		
	CS	NF	RM
"HYDRACARINA"			
<i>Acarina</i>	1		2
AMPHIPODA			
<i>Crangonyx</i>	123	14	48
BRANCHIOBDELLIDA			
Branchiobdellida			1
COLEOPTERA			
Dytiscidae	1	3	1
<i>Ectopria nervosa</i>	20	3	3
<i>Laccobius</i>			1
<i>Optioservus sandersoni</i>	7		2
<i>Stenelmis</i>			1
DECAPODA			
<i>Faxonius punctimanus</i>	*	1	*
DIPTERA			
Ceratopogoninae	10	3	3
<i>Chaetocladius</i>			2
Chironomidae	1	1	
<i>Cricotopus/Orthocladius</i>	4		
<i>Diamesa</i>	1		
<i>Dixa</i>	5	1	3
Dolichopodidae	*		
<i>Eukiefferiella</i>	2		1
<i>Hexatoma</i>	8		1
<i>Micropsectra</i>	10	1	18
<i>Microtendipes</i>	3	85	20
<i>Myxosargus</i>			1
<i>Neozavrelia</i>	1		1
<i>Nilotanytus</i>	1		1
<i>Parametriocnemus</i>	4		1
<i>Paratendipes</i>	6	82	4
<i>Polypedilum aviceps</i>	1		
<i>Polypedilum scalaenum grp</i>		7	2
<i>Pseudolimnophila</i>	7		2
<i>Ptychoptera</i>	*		*
<i>Rheotanytarsus</i>	2		7

ORDER: TAXA	Habitat		
	CS	NF	RM
<i>Smittia</i>	1		
<i>Stempellina</i>	17	1	
<i>Stempellinella</i>	1	1	1
<i>Stictochironomus</i>		41	6
<i>Thienemanniella</i>	8	2	2
<i>Thienemannimyia</i> grp.	11		2
<i>Tribelos</i>		1	
<i>Tvetenia bavarica</i> grp	20	1	17
EPHEMEROPTERA			
<i>Acentrella</i>	4		4
<i>Baetis</i>	10	1	7
<i>Dipheter</i>	20	1	10
<i>Stenacron</i>		3	*
HEMIPTERA			
<i>Microvelia</i>	1		
<i>Trepobates</i>		1	1
ISOPODA			
<i>Lirceus</i>	243	10	109
MEGALOPTERA			
<i>Nigronia serricornis</i>	*		*
<i>Sialis</i>		*	
ODONATA			
<i>Calopteryx</i>			1
<i>Cordulegaster</i>	*	*	*
<i>Somatochlora</i>			*
<i>Stylogomphus albistylus</i>			*
PLECOPTERA			
<i>Amphinemura</i>	24		9
<i>Clioperla clio</i>	1		
<i>Haploperla</i>	2		
Leuctridae	59		2
TRICHOPTERA			
<i>Cheumatopsyche</i>	3		
<i>Chimarra</i>	1		
<i>Diplectrona</i>	*		2
<i>Lepidostoma</i>	1	2	15
<i>Ochrotrichia</i>	3	1	19
<i>Pycnopsyche</i>	*	*	*
<i>Rhyacophila</i>	*		
TRICLADIDA			

ORDER: TAXA	Habitat		
	CS	NF	RM
Planariidae	1		3
TUBIFICIDA			
Enchytraeidae	1		
<i>Limnodrilus hoffmeisteri</i>		3	
Tubificidae	3	17	2
VENEROIDA			
Pisidiidae	3	3	2

Taxa collected by MST volunteers in Spring Branch (MST 1) at BCSP, Douglas County, Missouri.

Order: Taxa	Adult Count	Immature Count	Collector
BASOMMATOPHORA			
<i>Physella acuta</i>		9	R.J. Sarver; Allan Keller
<i>Physella gyrinus</i>		13	R.J. Sarver; Allan Keller
COLEOPTERA			
<i>Agabus</i>	1		R.J. Sarver
<i>Agabus/Ilybius</i>		2	Allan Keller
<i>Ectopria</i>		4	R.J. Sarver; Allan Keller
<i>Peltodytes</i>		2	Allan Keller
DIPTERA			
<i>Anopheles</i>		1	R.J. Sarver
<i>Bittacomorpha clavipes</i>	2		R.J. Sarver
<i>Stegopterna</i>		1	Bob Ranney
EPHEMEROPTERA			
<i>Acentrella</i>		1	Allan Keller
<i>Ameletus lineatus</i>		14	R.J. Sarver; Allan Keller; Bob Ranney
<i>Baetis</i>		1	Allan Keller
<i>Dipheter hageni</i>		1	Bob Ranney
<i>Iswaeon</i>		1	Bob Ranney
<i>Leptophlebia nebulosa</i>	2		Bob Ranney
<i>Leptophlebia</i>		4	R.J. Sarver
Leptophlebiidae		2	R.J. Sarver
<i>Paraleptophlebia sticata</i>	1		R.J. Sarver
<i>Siphonurus marshalli</i>		5	Bob Ranney
HEMIPTERA			
<i>Notonecta</i>		1	Allan Keller
MEGALOPTERA			
<i>Chauliodes pectinicornis</i>		1	Allan Keller
<i>Nigronia serricornis</i>		2	R.J. Sarver
ODONATA			
<i>Aeshna</i>		1	Allan Keller
<i>Archilestes grandis</i>		2	Allan Keller
<i>Calopteryx</i>		3	R.J. Sarver; Allan Keller
<i>Libellula</i>		1	R.J. Sarver
PLECOPTERA			
<i>Amphinemura delosa</i>	8		R.J. Sarver
<i>Amphinemura</i>		3	R.J. Sarver; Allan Keller; Bob Ranney

Order: Taxa	Adult Count	Immature Count	Collector
<i>Clioperla clio</i>	1	6	R.J. Sarver; Allan Keller; Bob Ranney
<i>Isoperla ouachita</i>	1	1	R.J. Sarver; Allan Keller
<i>Perlesta</i>		1	Allan Keller
TRICHOPTERA			
<i>Agapetus illini</i>	6		R.J. Sarver
<i>Agapetus</i>		7	R.J. Sarver; Bob Ranney
<i>Chimarra aterimma</i>		3	R.J. Sarver
<i>Chimmara</i>	1		R.J. Sarver
<i>Diplectrona modesta</i>		3	R.J. Sarver
<i>Glossosoma intermedium</i>		5	Bob Ranney
<i>Ironoquia punctatissima</i>		10	R.J. Sarver; Allan Keller; Bob Ranney
<i>Pyncnopsyche</i>		1	Allan Keller
<i>Wormaldia</i>		1	Allan Keller

Taxa collected by MST volunteers at Tributary to Bryant Creek (MST 2) in BCSP.

Order: Taxa	Adult Count	Immature Count	Collector
AMPHIPODA			
<i>Crangonyx</i>		14	R.J. Sarver; A. Keller; B. Ranney
BASOMMATOPHORA			
<i>Physella acuta</i>		4	R.J. Sarver
COLEOPTERA			
<i>Ectopria</i>		4	R.J. Sarver
<i>Sanfilippodytes</i>	1		R.J. Sarver
Scirtidae		1	R.J. Sarver
DECOPODA			
<i>Faxonius</i>		1	R.J. Sarver
EPHEMEROPTERA			
<i>Diphetor hageni</i>		1	R.J. Sarver
<i>Leptophlebia</i>		11	R.J. Sarver; Bob Ranney
Leptophlebiidae		1	R.J. Sarver
<i>Neocloeon alamance</i>		4	R.J. Sarver; Allan Keller
<i>Paraleptophlebia</i>		2	Bob Ranney
HEMIPTERA			
<i>Gerris</i>		1	R.J. Sarver
<i>Microvelia</i>		2	Bob Ranney
ISOPODA			
<i>Lirceus</i>		25	R.J. Sarver; A. Keller; B. Ranney
MEGALOPTERA			
<i>Chauliodes pectinicornis</i>		1	R.J. Sarver
<i>Sialis</i>		1	R.J. Sarver
PLECOPTERA			
<i>Alloperla</i>		1	Allan Keller
<i>Amphinemura</i>		1	Bob Ranney
TRICHOPTERA			
<i>Diplectrona modesta</i>		5	R.J. Sarver
<i>Ironoquia punctatissima</i>		2	Allan Keller
<i>Ironoquia</i>		2	R.J. Sarver
<i>Lepidostoma</i>		1	Bob Ranney
<i>Neophylax concinnus</i>		5	R.J. Sarver
<i>Pyncnopsyche</i>		3	R.J. Sarver; Bob Ranney
<i>Wormaldia</i>		2	Bob Ranney
TRICLADIDA			
Planariidae		1	R.J. Sarver

Taxa collected by MST volunteers at Tributary to Spring Creek (MST 3) in BCSP, Douglas County, Missouri.

Order: Taxa	Adult Count	Immature Count	Collector
BASOMMATOPHORA			
<i>Phyella acuta</i>		2	R.J. Sarver; Bob Ranney
<i>Phyella gyrinus</i>		5	R.J. Sarver; Allan Keller
COLEOPTERA			
<i>Agabus</i>	1		Randy Sarver
<i>Agabus/Ilybius</i>		2	Allan Keller
<i>Ectopria</i>		1	R.J. Sarver
<i>Helichus</i>		1	R.J. Sarver
Scirtidae		1	Bob Ranney
DIPTERA			
<i>Limonia</i>		1	Bob Ranney
EPHEMEROPTERA			
<i>Ameletus lineatus</i>		7	Allan Keller
<i>Ameletus</i>		1	Randy Sarver
<i>Siphonurus marshalli</i>		16	R.J. Sarver; A. Keller; B. Ranney
<i>Siphonurus</i>		1	R.J. Sarver
<i>Stenonema femoratum</i>		1	Bob Ranney
HEMIPTERA			
<i>Gerris</i>		1	R.J. Sarver
<i>Microvelia</i>		5	R.J. Sarver
ISOPODA			
<i>Lirceus</i>		1	Bob Ranney
MEGALOPTERA			
<i>Nigronia serricornis</i>		1	Bob Ranney
ODONATA			
<i>Boyeria vinosa</i>		4	Allan Keller
<i>Calopteryx</i>		1	R.J. Sarver
<i>Libellula semifasciatus</i>		1	R.J. Sarver
PLECOPTERA			
<i>Allocaonia mohri</i>	16		R.J. Sarver
<i>Amphinemura</i>		1	Allan Keller
<i>Clioperla clio</i>		1	Allan Keller
<i>Isoperla ouachita</i>		3	Allan Keller
<i>Zealeuctra</i>	2	5	R.J. Sarver
TRICHOPTERA			
<i>Agapetus</i>		5	R.J. Sarver

Order: Taxa	Adult Count	Immature Count	Collector
<i>Diplectrona modesta</i>		1	Bob Ranney
<i>Frenesia missa</i>		1	Allan Keller
<i>Helicopsyche limnella</i>		7	R.J. Sarver
<i>Ironoquia punctatissima</i>		5	R.J. Sarver; Allan Keller
<i>Neophylax concinnus</i>		1	R.J. Sarver
<i>Paduniella nearctica</i>		1	R.J. Sarver
<i>Pyncnopsyche</i>		1	Allan Keller